Template-Directed Convective Assembly of 3D Colloidal Crystals I

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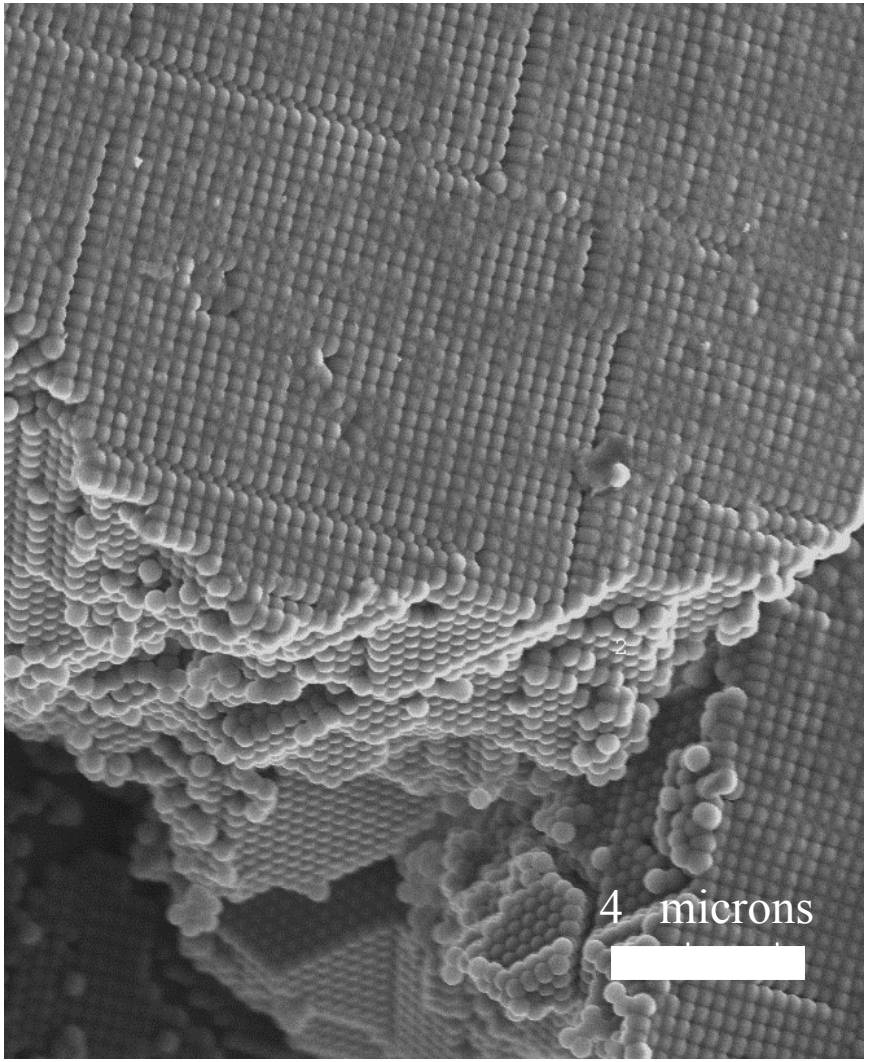
It is difficult, but desirable to create patterned nano- and micro-scale materials ordered in three-dimensions. Such materials can have novel optical properties and chemical applications. One important route for creation of three dimensional (3D) patterned materials is through self-assembly. Such crystals can form spontaneously in thermal equilibrium, or via non-equilibrium schemes facilitated by gravity, electro-hydrodynamic forces, chemical forces, injection forces, or convection. Convective assembly is arguably one of the simplest methods for creation of ordered particle structures. It has been used with success to make two-dimensional and three dimensional monodisperse and binary colloidal structures, and even to make heterostructures.

We have demonstrated that square two-dimensional grating templates can drive the growth of three-dimensional, face-centered-cubic (FCC) colloidal crystals by convective assembly. The square symmetry (i.e. (100) planes parallel to the substrate) of the underlying template was transferred to the colloidal crystal and maintained throughout its growth of ***~50*** layers. We characterized crystals grown on flat and on templated substrates using electron microscopy and small-angle x-ray scattering (SAXS). SAXS measurements of the templated



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samples clearly show four-fold diffraction patterns arising from FCC domains without stacking faults.

Our project involves two different groups (A.G. Yodh and P. Heiney groups) from astronomy & physics department from university of Pennsylvania. We also used the SAXS facility in Advanced Photon Source to characterize our samples.

Educational:
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Template-Directed Convective Assembly of 3D Face-Centered-Cubic Colloidal Crystals, J.Zhang, A.Alsayed, K.H.Lin, S.Sanyal, F.Zhang, W.J.Pao, V.S.K.Balagurusamy,P.A.Heiney, and A.G.Yodh, submitted to *Appl. Phys. Lett.*

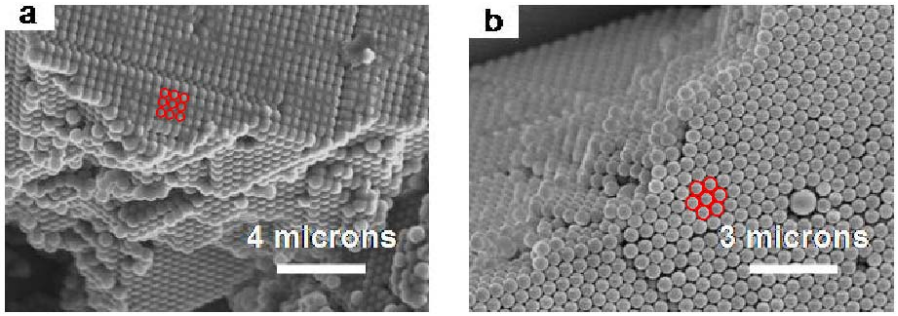

FIG. 2. SEM pictures of the crystals convective assembled (a) with template and (b) without template. The particle diameter was ~ 500 nm, and the template period was 550 nm.

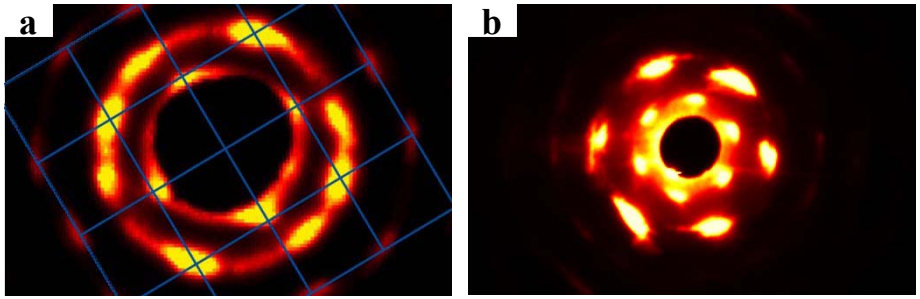

FIG. 3. Diffraction pattern from convective assembled crystals (a) Hexagonal domains (without template) and (b) Square domains (with template). In Fig (b), the superimposed grid helps with recognition of the X-ray spots due to the sample's square symmetry.